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March 8, 1993

Reply To
Attn Of: HW-124

Ms. Lisa Green
Environmental Restoration Division
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Re: Results of the Pilot-Scale Treatability Study for the Test Reactor Area Warm Waste Pond, Volume I and Volume II

Dear Ms. Green:

Enclosed are the U.S. Environmental Protection Agency (EPA) comments to the Draft Pilot Scale Treatability Study.

Our review focused on the feasibility of implementing the physical/chemical extraction remedy for the Warm Waste Pond sediments. The enclosed comments are specific to the above referenced report. Additional information was provided during the study period, research conducted by Nuclear Remediation Technologies, (NRT) as well as technical memorandums. This information supports implementing an alternative remedy, outlined in the Explanation of Significant Difference, (ESD) to reduce immediate risks posed by the Warm Waste Pond. Based on information obtained during this study it appears that the amount of waste generated in the chemical extraction process, it is not prudent to proceed with the physical/chemical extraction remedy proposed in the Record of Decision.

The conclusion presented in the Pilot-Scale report, that the criteria outlined in the Record of Decision can not be met, is not fully supported. It appears, based on the enclosed calculations, that the criteria can be met, however, the volume of waste generated and subsequently requiring long-term management would not justify the cost and long-term benefit.

The NRT study concluded the goals could be easily achieved, however this conclusion was based on a very low activity sample(2000 pCi/g). When tested on a sample with substantially greater activity (55,000 pCi/g) the results were less promising. The recommendations and conclusions presented by NRT should be included for comparison with the WINCO and TCT studies.

In closing, we would like to emphasize, we fully support implementing an alternative remedy, which will be outlined in an the ESD. This treatability study has resulted in a greater understanding of the chemical mechanism of adsorption of cesium in this environment which will be valuable information for future investigations at similar sites.

If you have any questions concerning the enclosed comments please feel free to contact me at (206) 553-6636.

Sincerely,

Linda Meyer

Linda Meyer
WAG 2, Remedial Project Manager

Enclosure

cc: w/enc.

Alice Williams, DOE
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Dave Hovland, IDHW
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TEST REACTOR AREA

WARM WASTE POND TREATABILITY STUDY

This review focused on five key parts of the study, and on the conclusions and recommendations. The comments address only cesium, since it is the primary risk driver at the site, and treatment technologies aimed at removing cesium appear to remove the other contaminants of concern as well. In Attachment A, calculations for an alternative treatment scenario are provided. Comments are divided into the following five sections:

- Particle size and radionuclide distribution of the warm waste pond (WWP) sediments
- Effectiveness of acid washing for cesium removal
- Effectiveness of sequential extraction for cesium removal
- Comparison of the acid wash extractant to Idaho Chemical Processing Plant (ICPP) waste acceptance criteria (WAC)
- Conceptual design and order-of-magnitude costs for alternative treatment trains
- Results and conclusions

GENERAL COMMENTS

Acid Wash Treatment

The data provided by TCT's acid washing studies show a clear positive relationship between increased cesium removal and an increase in nitric acid concentration, temperature, and time. The conclusion that the optimum treatment scheme is to use a lower 3M nitric acid solution, balanced by a higher temperature (95°C), and a longer extraction time (8 hours) is supported by the data. This procedure generates wastes of lower acidity than 6M or 12M extraction. Using the optimum conditions, the data show that approximately 80 percent of the cesium can be removed in a single wash, and 90 percent in a double wash.

The study incorrectly concludes that this treatment technology is inadequate to meet the ROD goal of reducing the cesium concentration to below 690 pCi/g in 60 percent of the sediments. The study only considered size separation as a gross first step to remove the coarse fractions, with acid wash treatment applied only to the fines. An alternative treatment scheme would be double-stage acid washing of only the coarse fraction above the number 50 mesh (which makes up approximately 91 percent of the sediment volume according to Table 3-2, page 3-3). With this method, it appears possible that approximately 60 percent of the soil could be reduced to an average cesium activity of 690 pCi/g. This includes losses for matrix dissolution in a double acid wash treatment system as calculated in Attachment 1. The fines have already functioned as a natural sorption medium and their removal can be viewed as a pretreatment step for removal of the most highly contaminated sediments, leaving treatable soils behind. However, the net result of such a treatment process could be that the volume of waste sludge generated from using chemical complexing agents, pH adjustment, or resin beads could equal or exceed the volume of soil cleaned by screening, creating no net advantage. The sludge could be even more difficult to dewater and dispose of than untreated soil. If soil washing is to be rejected, it should not be for the reason stated in the study. Instead, the study should include a mass balance to determine the final amount of contaminated solids requiring disposal.

Sequential Extraction

The data presented in the sequential extraction study (Appendix B) support the conclusion that this method is inadequate for treating WWP sediments. Only 18 percent of the cesium was removed on average from all extraction steps combined. However, the sequential extraction study also demonstrated that the addition of potassium nitrate greatly boosted the effectiveness of cesium removal by each reagent. It is likely that the addition of potassium nitrate to the optimum acid wash treatment selected in the WINCO study would also significantly increase the efficiency of the acid wash process. This could allow treatment of more of the fines, or treatment of the coarse fraction to levels even lower than 690 pCi/g cesium, if desired.

Volume I, Section 2.2.2.6

This section specifies a final lattice phase digest with hydrochloric and nitric acid at 50 C. It is not clear what the results of this step were.

Appendix B, Section 4.6, Paragraph 2

Please clarify how this information relates to representative samples.

Appendix B, Section 6.0, Conclusions and 7.0 Recommendations

Conclusions and recommendations are not fully supported by the research conducted. The purpose of this Appendix should be to present results of the research conducted and not opinions of the document preparer. Several statements concerning half lives and natural decay, plant uptake and this technology not being "practical", should be clarified and supported by the research.

Acid Wash Extractant and ICPP WAC

Data from the report show that acid wash extractant would not meet the ICPP WAC. None of the treatment technologies tested was able to clean the extractant enough to satisfy ICPP WAC. However, complexation with ammonium phosphomolybdate followed by pH adjustment successfully removed most of the ICPP WAC constituents. It is possible that further treatment could allow the extractant to meet the ICPP WAC.

Acid Wash Conceptual Design and Cost Estimate

The study presented a conceptual design for a treatment train that would separate out the coarse fraction above mesh 8, acid wash the fines, and treat the extractant. Three alternatives were included for the extractant (ICPP treatment, ion exchange, and chemical precipitation-complexation). Estimated costs for acid washing followed by one of the three extractant treatment options are $21.2, $23.5, and $26.3 million respectively. Closer examination of the conceptual design and cost estimates in Appendix A, Table 5-3, page 5-8, shows that more than half of the cost for each option is for reagents to treat the extractant. Several of the most significant costs are not adequately backed up by the cost summary and calculations (Appendix A, Attachment L) as listed below:

- The cost for the estimated 3,027 gallons per day of nitric acid for the soil wash step was not estimated or included in the total cost. This cost should be provided.
- The rationale for the NaOH cost of $3.1 million was not included and should be.
- Recycling of the nitric acid solution should be considered as a method to lower the cost for reagents and reduce the amount of hydroxide sludge that requires disposal.
- The rationale for the $14.4 million for ICPP acceptance for option no. 1 should be explained.
- The rationale for the ammonium phosphomolybdate cost of $15.1 million should be explained.
- The calculations for the amount of Cs-100 resin required are not clear and cannot be verified. This is a major cost ($12.4 million). Complete assumptions and calculations should be provided, and regeneration of the Cs-100, as suggested in the manufacturer's technical sheet in Appendix A, Attachment G, should be considered to reduce costs and the volume of spent resins for disposal.
- The capital cost for the concrete pad with containment is the single largest capital cost ($.44 million), but is not well supported. The proposed size of 90,000 square feet should be justified, and the reason for doubling the pad cost for "containment" should be explained.
- The log washer is another major capital cost item ($0.34 million), which may not be required, especially if the coarse fraction is acid washed, rather than the fine fraction. This unit should be justified or removed from the treatment train.
- The concrete pad for stockpiling WWP sediments is unnecessary if the sediments are stockpiled in one of the existing ponds. No additional substrate would be contaminated if the soil were stockpiled on top of

already-contaminated sediments. Upon completing treatment of the stockpiled soil, the soil under the stockpile could be excavated in the same manner as the rest of the soil. The concrete stockpile pad should be removed from the treatment train.

- Several of the operation and maintenance items are based on arbitrary proportions of the capital costs:

    - Analytical/monitoring/safety, 20 percent of capital costs ($0.62 to $0.72 million)

    - Steam/electrical/energy, 25 percent of capital costs ($0.77 to $0.9 million)

    - Equipment/maintenance, 20 percent of capital costs ($0.62 to $0.72 million)

    These costs should be justified.

- Much of the extractant treatment focused on removal of cesium, but it is not clear whether this is required since the ICPP WAC do not address cesium directly. The ICPP WAC given in Table 4-2, page 4-6, show a standard for gross beta emissions, which the extractant meets. The ICPP WAC for cesium should be determined, and the extractant treatment should be designed to meet that standard.

- The cost estimate should include a table showing mass estimates of the various sludge and resin wastes to result from the proposed treatment. It is not clear whether the net result of the proposed treatment would yield any reduction in volume of solid materials requiring disposal compared to the original soil volume.

New costs should be estimated using the assumption that the coarse fraction will be treated, potassium nitrate will be used, and the above discrepancies addressed.

Conclusions and Recommendations

While the report provided much useful data and fulfilled many of its objectives, some of the key conclusions are not adequately supported. As discussed above, the report has not demonstrated that acid washing cannot meet the ROD goal of 690 pCi/g. The study data show that this level can be achieved if acid washing is applied to the coarse fraction.

Also, the addition of potassium nitrate to the acid wash process to prevent resorption of the cesium could greatly increase the effectiveness, as suggested by the sequential extraction study. This could also make it possible to treat the soil in a single wash, resulting in less dissolution of the soil matrix.

The conclusion that the cost of the remedial action will exceed the ROD estimate by a factor of 3 is not supported by the cost estimate provided. Many units are included in the conceptual design that may not be needed, while some of the major costs are not adequately justified.

To support the conceptual design suggested above, additional pilot scale testing of acid washing of the coarse fraction, using potassium nitrate, would be needed. Before this is done, it is recommended that a mass balance be calculated to show the net amounts of soil fractions and sludge residues that require disposal as radioactive, mixed, or hazardous wastes. If it appears that there will be a significant net reduction in volume of such wastes from the original sediment volume, a new conceptual design and cost estimate should be prepared. If no significant net volume reduction can be shown, then the conclusion that soil washing is not feasible will be justified, and further treatability testing of soil washing will not be necessary.

ATTACHMENT 1

CALCULATIONS:

SOIL REMEDIATED BY ACID WASHING THE COARSE FRACTION

prc Environmental Management, Inc.

CALCULATION/WORK SHEET SHEET 1 OF 2

PROJECT: INEL Draft Results of the Pilot Scale Treatability Study for the Test Reactor Area warm waste Pond	COMPONENT/SYSTEM Technical Review comments - Calculation of Treated Soil volume

PREPARED BY:	DATE:	CHECKED BY:	DATE:
James P. Wright	2/16/93		

Calculate percent of pond sediments that could be treated to less than 640 pCi/g

Assumptions:

- Removal of Ce activity is 89.% % effective using 2 stage acid extraction with 3N HNO_3 - Vol. 1, page 4-4

- Sediment matrix dissolution after 2 stage acid wash is 32% - Vol. 1, page 4-4

- % removal is calculated by:

$$\% \text{ removal} = [C_{e1}] - [C_{e2}] / [C_{e1}] \quad \text{- Vol. 2, page 4-23}$$

- $[C_{e1}]$ initial cesium activity in pCi/g
- $[C_{e2}]$ cesium activity after treatment

Calculate Cs activity for all soil larger than mesh 50. Weight % values are from table 3-2, page 3-3, Vol. 1. [Ce] = cesium activity in pCi/g

- 92.01% of soil by mass is larger than 50 mesh - volume 2, page 4-2

$$[C_s] = \sum_{i=\text{mesh } 4}^{\text{mesh } 50} \left(\text{Weight Fraction } [C_s]\right)_i$$

$$= \frac{.5794(3,825) + .1121(5,965) + .0841(10,473) + .1445(18000)}{.9201}$$

$$[C_s] = 6,919.5 \text{ pCi/g}$$

prc Environmental Management, Inc.

CALCULATION/WORK SHEET SHEET 2 OF 2

PROJECT:		COMPONENT/SYSTEM	
PREPARED BY:	DATE:	CHECKED BY:	DATE:

Calculate final activity of soil after treatment

$$\text{removal efficiency} = .899 = \frac{[Ce_1]-[Ce_2]}{[Ce_1]}$$

$$.899[Ce_1] = [Ce_1]-[Ce_2]$$

$$[Ce_2] = [Ce_1] - .899[Ce_1]$$

$$[Ce_2] = 6,919.5 - .899(6,919.5)$$

$$\boxed{[Ce_2] = 698.8\ pCi/g}$$

$698.8 \approx 690$ O.K.

Calculate mass of treated soil remaining after matrix dissolution based on 100 lbs of untreated soil initially

$100\text{ lbs} \times .9201 = 92.01\text{ lbs} > \text{mesh } 50$

$92.01 - .32(92.01) = 62.57\text{ lbs}$ remaining after matrix dissolution

$$\boxed{\%\text{ remaining for replacement} = \frac{62.56}{100} = 62.5\%}$$

→ 62.5% is greater than ROD goal of 60% of soil for replacement